

LIVERMORE LAB REPORT

A weekly review of scientific and technological achievements from Lawrence Livermore National Laboratory, July 29-Aug. 2, 2013.



Lab researchers Kim Cupps and Adam Bertsch are among those using the 20-petaFLOPS Sequoia machine to solve some of the biggest scientific problems.

Today's supercomputers are marvels of computational power, and they are being used to tackle some of the world's biggest scientific problems.

Current models are tens of thousands of times faster than the average desktop computer. They achieve these lightning-fast speeds via parallel processing, in which many computer processors perform computations simultaneously. Supercomputers are used for everything from forecasting weather to modeling the human brain.

Testing nuclear weapons has been banned in the United States since 1992, but supercomputer simulations ensure that the nation's nukes remain safe and functional. IBM's Sequoia supercomputer at Lawrence Livermore is designed to replace testing of nuclear explosions with improved simulations.

To read more, go to [NBC News](#).



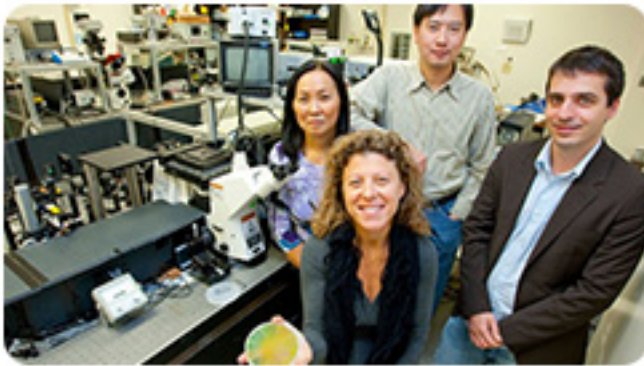
The preamplifiers of the National Ignition Facility, the world's largest and most energetic laser.

For the past four years, physicists at the National Ignition Facility have been trying to create nuclear fusion. In other words, they have been searching to produce the same reaction that powers the sun and the stars on Earth.

Supporters believe that a successful outcome to the experiments could help usher in an era of nearly limitless energy. Physicists have been pursuing the dream of controlling fusion energy for some 60 years now. For fusion to occur -- to force two nuclei to join -- physicists must replicate the hellish temperatures and pressures found inside stars.

NIF seeks to do that with 192 giant lasers, which occupy a space as large as three football fields. Fired simultaneously, the laser beams blast a peppercorn-size speck of frozen hydrogen suspended in a 30-foot-wide target chamber with about 500 trillion watts of power -- about 1,000 times the amount of energy used by the entire United States during that same few trillionths of a second.

To read more, go to National Geographic.



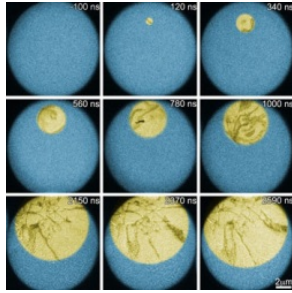
An LLNL team is working to increase the efficiency of solar cells to store energy.

Lawrence Livermore researchers have discovered the use of black metals increases the efficiency of solar cells to harvest energy.

The LLNL Materials Engineering Division (MED) research team has made breakthroughs experimenting with black metals. These nanostructured metals are designed to have low reflectivity and high absorption of visible and infrared light.

Black metals are not classic metals but can be thought of as an extension of the black silicon concept. When silicon is treated in a certain way, such as being roughened at the nanoscale level, it traps light by multiple reflections, increasing its solar absorption. This gives the silicon a black surface that's able to better trap the full sun's wavelength spectrum.

To read more, go to [Red Orbit](#).



Multi-frame, nanosecond-scale imaging captures what could not be seen previously with conventional microscopy.

Researchers from Lawrence Livermore for the first time have created movies of irreversible reactions that occur too rapidly to capture with conventional microscopy.

The team used multi-frame, nanosecond-scale imaging in the dynamic transmission electron microscope (DTEM) to create movies of the crystallization of phase change materials used for optical and resistive memory. A phase-change material (PCM) is a substance that can be switched between an amorphous and a crystalline state with rapid heating.

Optical memory (compact discs and DVDs) and nonvolatile Random Access Memory (RAM) use the distinct optical and electrical properties of the amorphous and crystalline phases of PCMs. For memory applications, it is necessary to switch between the amorphous and crystalline phases in nanoseconds by rapid heating.

To read more, go to [ASM International](http://asminternational.org).



RENEWABLES ARE PICTURE OF GOOD HEALTH



Wind power saw the highest energy gains from 2011 to 2012, according to the most recent U.S. energy flow charts released by the Lawrence Livermore. Photo by Charles McGregor/LLNL

Renewable energy production hit an all-time high in the United States in 2012, according to a recent report put out by the Lawrence Livermore.

A combination of government incentives and technological innovations has helped solar and wind power grow in the United States in recent years, the report suggests. From 2011 to 2012, solar energy production increased by 49 percent and wind energy increased by 16 percent.

"I attribute the steady growth to technological advancements as well as tax incentives and state mandates for renewable energy," said A.J. Simon, an energy analyst at LLNL, who wrote the report. "I would expect this to continue for a while."

Though the trend is notable, wind and solar energy combined still accounted for only about 2 percent of total U.S. electricity consumption in 2012. Denmark and Spain, in comparison, produced an average of about 30 percent of their energy from wind power last year.

To read more, go to [Live Science](#).

LLNL applies and advances science and technology to help ensure national security and global stability. Through multi-disciplinary research and development, with particular expertise in high-energy-density physics, laser science, high-performance computing and science/engineering at the nanometer/subpicosecond scale, LLNL innovations improve security, meet energy and environmental needs and strengthen U.S. economic competitiveness. The Laboratory also partners with other research institutions, universities and industry to bring the full weight of the nation's science and technology community to bear on solving problems of national importance. To send input to the *Livermore Lab Report*, send [e-mail](#)